SPARK GAP

Vol. 41, Issue 11, November 2024 *MARC - Serving Central Indiana Communities*

On Our MARC:

Please join us Saturday morning at 8 am for our November MARC monthly meeting. We meet at the Johnson County REMC building in Franklin. Our December meeting will be a pitch in brunch, so please plan to bring a dish to share. We will also hold our annual white elephant gift exchange. Don't feel like you need to spend money, just bring something from the shack you don't need any more. If you choose to purchase a gift, please keep it under $10.

We look forward to seeing you Saturday.

Tim
WC9G

Have a Happy Thanksgiving from M.A.R.C.

November Birthdays

WC9G --- Tim Aldridge
AD9CR --- Kyle Burns
WS9H --- Rhonda Curtis
WB9CVG --- James Jeffery
W9TEJ --- Ron Koons
W9YD --- John Wampner

M.A.R.C. Holiday Brunch

December 21st, 8 AM

Weather Ops-ervations
by KC9NJM

Since 1998 a dedicated and growing group of volunteers have been faithfully venturing into their backyards each day to gather precipitation reports for an organization called CoCoRaHS, the Community Collaborative Rain, Hail & Snow Network. What began with a handful of families in Fort Collins, CO for the purposes of reporting rainfall to the National Weather Service has today grown into an organization with over 26,000 active observers in the United States, Canada, Puerto Rico, the U.S. Virgin Islands, Guam, and the Bahamas. The trained observers yield approximately 31 million daily precipitation reports per year. The majority of the reports are for rain and are measured with a reasonably-priced, and officially-approved, 4" gauge. Some observers will additionally report snow, sleet, ice accumulation, and hail.

According to the CoCoRaHS website, www.cocorahs.org, submitted precipitation data is used by the NWS, other meteorologists, hydrologists, emergency managers, city utilities, insurance adjusters, USDA, engineers, mosquito control, ranchers and farmers, outdoor & recreation interests, teachers, students, and others.

The Indiana CoCoRaHS coordinators are always looking for people who are interested in joining the organization and it is open to all ages and backgrounds. While training is occasionally offered in-person, it is more frequently done online with a prepared presentation. Those wanted to become observers would need to contact an Indiana coordinator to express your interest. The coordinator for Johnson and most of the surrounding counties is Andrew White, whose email address is andrew.j.white@noaa.gov. He will be able to guide you through the registration process, advise you about the training, and give you information about the purchase and set-up of your gauge. There is no cost to participate in the program other than the purchase of your gauge and any mounting materials you may need. Electronic gauges are not approved for use in this program due to their variability.

If you have questions or would like to know more about the program, I would encourage you to explore the CoCoRaHS website listed above. I have been a part of this program for over 15 years and have logged over 5000 daily reports, so if you would like to know more about my personal experience with the organization, please feel free to contact me at weather@midstatehams.org.

Sources: NWS, Community Collaborative Rain, Hail, & Snow Network

A TDOA Antenna Unit for Fox-Hunting

At some point in your hunt for the elusive "fox", you will (with luck) be so close that simple field-strength direction-finding techniques may no longer work. The "fox"'s signal will be so strong that it will swamp your attenuator and leak through the plastic parts of your radio's case, resulting in "S9+" signal-strength readings in every direction, regardless of attenuator settings or antenna orientation. A "Time Difference of Arrival (TDOA)" antenna unit will put you back on the "hunt".

(How big a truck will I need?)

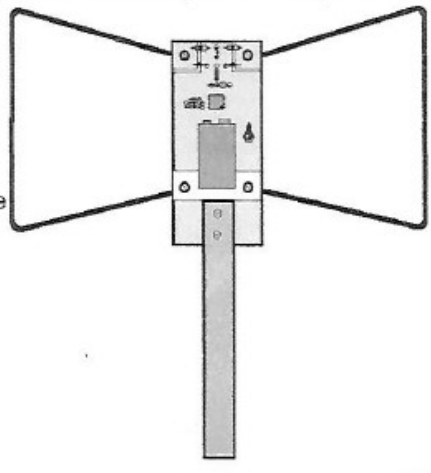
A TDOA antenna unit is simple and easy to build, and will work with any 2m FM mobile or handheld. There are many different designs of TDOA units, and some have additional "bells and whistles" (such as left/right indicators), but the basic design (which is all you really need) consists of a small dual-antenna array and an electronic antenna-switching unit.

The antenna array usually consists of two vertical dipole antennas separated 12 to 36 inches apart, often mounted on a T-shaped support so that the array can be rotated. The purpose of the antenna-switching unit is to alternately and rapidly switch the input of your FM receiver between the two dipoles. The switching rate is typically 1000 times per second. Switching is accomplished by a square-wave oscillator which alternately forward- or reverse-biases diodes connected in the circuit path between each dipole and the receiver. Common silicon switching diodes will work OK, but PIN diodes work best.

(How does it indicate direction ?)

The TDOA works by detecting the difference in the phase of the RF signal received by each dipole. If both dipoles are exactly the same distance from the RF source (the "fox"), the phase of the RF signal will be the same at each antenna. If you rotate the array, or the RF source moves to the left or right, then one dipole will be closer to the source than the other one, causing a small phase difference between the signals received. Your FM receiver will then detect an abrupt change in the phase of the RF signal it receives as the antenna switching unit switches rapidly back and forth between the two dipoles. To the receiver, the signal looks like square-wave- modulated FM ! Your receiver's speaker will emit an audio tone at the antenna-switching frequency. As the phase difference increases, the tone becomes louder. When both dipoles are equidistant from the source, the tone almost completely disappears.

One disadvantage of the TDOA is that when you have found the "null" or antenna position where the tone disappears, you cannot tell if the source is directly in front of you or directly behind you. Fortunately, there are other ways to determine this. A quick way, if you are using a handheld, is to use the "body shield" method - disconnect the antenna, hold the handheld close to your chest so that you can see the signal strength indicator, and turn your body. When the indicated signal strength is minimum, the source is somewhere behind you. Another technique involves converting the TDOA antenna to one which has a cardioid or heart-shaped radiation pattern - the null (which corresponds to the "notch" in the heart-shape) can be used to point a rough bearing to the source.



A quick (1-2 evening) TDOA antenna unit

You can build a simple TDOA unit in an evening or two for about $10 or less (depending on the size of your junk-box). The circuit, shown in Fig. 2, is based on one in an article by Paul Bohrer (ref 1). U1 is a 555 timer powered by a 9V battery, oscillating at about 1kHz. R1, R2 and C1 determine the frequency of oscillation. The output of U1 is a square-wave from +9V to ground. C2 allows the square-wave to be level-shifted to between +4.5V and -4.5V. The positive half of the

square-wave's cycle turns on (forward-biases) D1 and turns off (reverse-biases) D2; the negative half of the cycle does the opposite. R3 and R4 limit the forward bias current for each diode to about 9mA. When the diode is turned on, the RF signal received by that diode's dipole is conducted through the diode and coupled through C4 to the coaxial cable to the receiver. When the diode is turned off, the RF signal (from that diode's dipole) is blocked. RFC1 presents a high impedance to the RF signal so that it is not shunted by the oscillator circuit, but passes the relatively low-frequency square-wave to the diodes. RFC1 together with C3 also comprise a low-pass filter to prevent the high-frequency components of the square-wave from getting into the antenna circuit and the receiver. If you forget to install C3 (I did), you'll hear a continuous "hash" of switching noise.

A rough PCB layout with approximate dimensions is shown in Fig. 3. Layout is not critical, but try to keep the wiring between the antenna elements, diodes and coax as short as possible. I also tried to keep the battery and coaxial cable exactly centered so that they would not affect one antenna element more than the other, but I'm not certain if this is really necessary. The coaxial cable lead to the receiver runs down the back of the PCB and through the PVC-pipe handle.

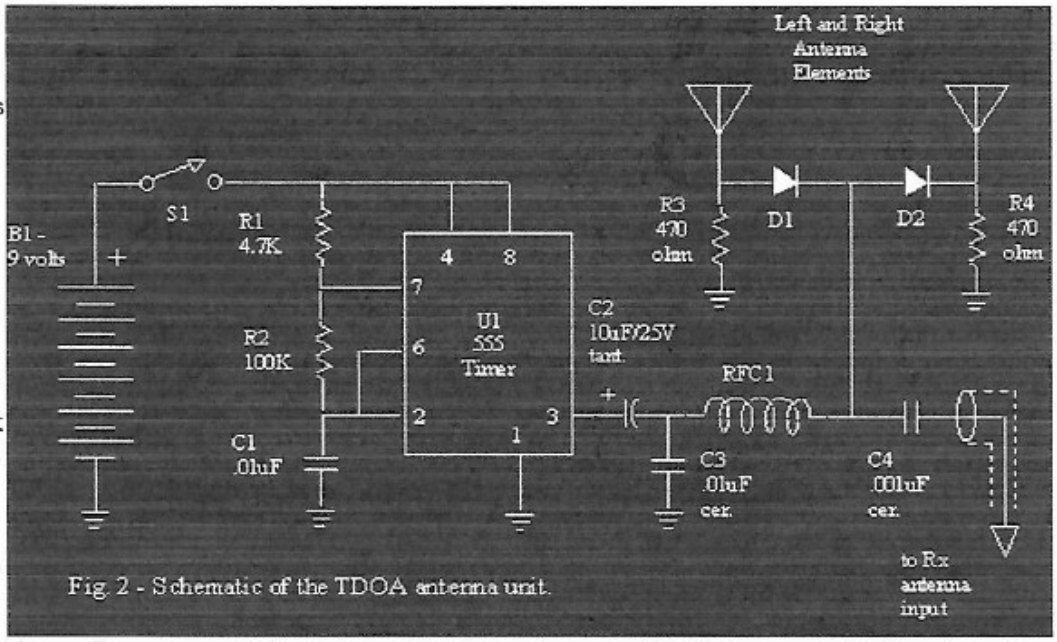


Fig. 2 - Schematic of the TDOA antenna unit.

The PCB can be "etched" using a sharp exacto-knife (watch your fingers!) and a drill-bit. Score around the areas of copper-clad that you want to remove with the exacto-knife, then peel away the copper. I use a pad-cutter tool to isolate pads in the copper, but you can clear the copper around holes with a sharp 1/8" drill bit - for a handle, use a 1/8"-shaft knob with set-screws. This prevents shorts between the copper ground-plane and component leads which pass through holes in the PCB.

I made a "bow-tie" antenna based on the "Handi-Finder" article (ref 2). Each element is a square "U", 6 inches across the bottom with 6-1/2" long arms. Each arm has a loop at each end for mounting to the PCB with #6 nuts and screws. It does not give as loud a tone or as sharp a null as two dipoles spaced 3 feet apart, but it's a lot smaller. I used coat-hanger wire, but stiff #12 copper wire or brass brazing rod would probably be better. The handle can be anything, preferably non-metallic, such as a short length of PVC pipe, wooden dowel or broomstick with a slot sawed in one end for the PCB.

Any 555 timer IC will work with this unit (there must be over 15 different semiconductor companies making them) but the CMOS part will nearly double your battery life. You can adjust R1 and C2 to vary the oscillator frequency (if you find a particular tone annoying). RFC1 is not especially critical, figure 1kohm impedance or better at 144MHz. If you have something in your junk-box, try it out by tuning your rig to a QSO

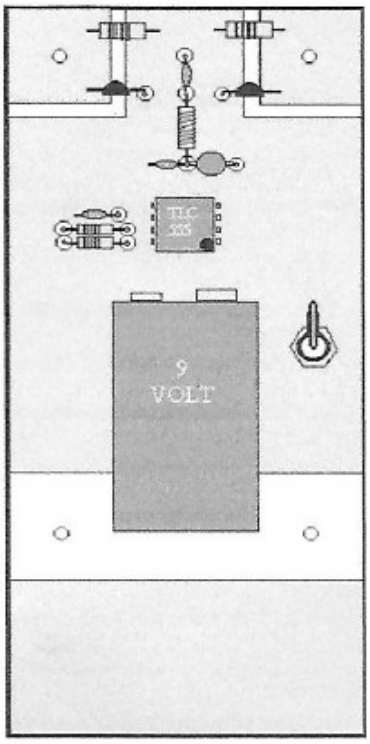


Fig. 3 - PCB component layout.

in progress with the TDOA antenna unit connected but not switched on, then touch the leads of the RFC between ground and the connection between D1 and D2. If the signal strength drops appreciably, then the RFC does not have a high enough impedance at VHF.

Using the TDOA antenna unit

TDOA antenna units are not designed for transmitting. If your handheld has a "TX inhibit" feature, it's a good idea to enable it when foxhunting with a TDOA. Transmitting into the TDOA may damage your HT, the TDOA, or both.

The TDOA works best with a strong, vertically-polarized signal. Strong multipath reflections caused by nearby vehicles, buildings, fences, powerlines, steel lamp-posts, etc. can make the null difficult to detect, or even appear on a wrong bearing. (Note that wily foxes look for places just like these to hide). If possible, look for open areas clear of obstructions and reflectors when taking bearings. If the bearing appears to change as you move around, your location may be affected by multipath. With practice, you'll be able to tell from the tone whether you have a good signal or one distorted by multipath.

Parts List for the TDOA Antenna Unit (Fig. 1)

1. U1 - CMOS 555 timer
2. R1 - 4k7, 1/4W, 5%
3. R2 - 100K, 1/4W, 5%
4. R3,4 - 470R, 1/4W, 5%
5. C1 - 0.01uF, 50V ceramic
6. C2 - 10uF, 25V tantalum
7. C3 - 0.01uF, 50V ceramic
8. C4 - 0.001uF, 50V ceramic
9. D1,2 - PIN diode, MPN3404
10. RFC1 - RF choke, 8 turns magnet wire space-wound over 1/4W carbon comp resistor (100k or greater).
11. S1 - Switch SPST (toggle or slide)
12. Misc. - PCB, 9volt battery, battery holder, stiff wire (for ant.), RG-58 coax and BNC connector.

Parts Sources - Toronto Area

- **Electro Sonic, 1100 Gordon Baker Rd., Toronto**
- -- PIN diodes : Motorola MPN3404
- -- 555 timer : National LMC555CN, Motorola MC1455P1
- -- 9V battery holder : Keystone No. 1291
- -- switches : Mode Electronics
- **Double-H Electronics, 3800 Victoria Park Ave., Toronto**
- **Daiwa Semitron, 3800 Victoria Park Ave., Toronto**
- -- copper-clad PCB (single- and double-sided)
- **Radio Shack**
- -- 555 timer : Texas Instr. TLC555
- **(all locations listed above carry the resistors and capacitors).**

References and related articles

1. "Foxhunt Radio Direction Finder", Paul Bohrer, W9DUU, 73 Magazine Jul '90, pp.9-11, (construction article for TDOA unit with left/right indicators).

2. "Build the HANDI-Finder!", Bob Leskovec, K8DTS, QST May '93, pp.35-38, (construction article). See also "Sense the Right Way to Go with the Handi-Finder", by Joe Moell, K0OV, QST Oct '93 Technical Correspondence, pp.77-78, for cardioid pattern modification.
3. "The HANDI-Finder", Dave Martin, W6KOW, 73 Magazine Dec '93, pp.26-27, (product review).
4. "Homing DF Units", Chapter 8, "Transmitter Hunting - Radio Direction Finding Simplified", Joseph D. Moell K0OV and Thomas N. Curlee WB6UZZ, TAB Books, 1987.
5. "Monitoring and Direction Finding", Chapter 38, The ARRL Handbook - 1993 (70th Edition), the Amateur Radio Relay League.
6. "Direction Finding Antennas", Chapter 14, The ARRL Antenna Handbook - 1991 (16th Edition), the Amateur Radio Relay League.
7. See also the "Homing In, Radio Direction Finding" column by Joe Moell, K0OV, every month in 73 Magazine.

Ed. note .....

Thanks to Art, WB9CHR for finding this article about making a good Fox Hunt antenna. Although it was published originally in the 1990's it has information that is good today. Paul Bohrer, W9DUU (SK) was a friend to MARC and hundreds of HAMs across the country.

New Drake TR5 Transceiver
far above average!
COMING SOON
RV75 Synthesized VFO
featuring the Drake "VRTO"
* Patent pending
With the new TR5
versatility and value are spelled D-R-A-K-E ...
DYNAMIC RANGE
The dynamic range of the TR5 is unexcelled by any transceiver in its class. The TR5's greater than 0 dBm third order intercept point (85 dB two-tone dynamic range) at 20 kHz spacing can be achieved only by the use of a passive diode-ring double balanced mixer. Drake was the first to bring this technology to the Amateur market with a high-level mixer in the TR7.
RELIABLE SERVICE
When you purchase a TR5, or any Drake product, you acquire a product of the latest production techniques, which provide reliable performance.
Yet with a product as sophisticated as one of today's transceivers, after-sales service is a must. Ask any Drake owner. Our Customer Service Department has a reputation second to none.
ACCESSORIES
Drake is the only Amateur Radio manufacturer who offers a full complement of accessories to satisfy almost every desire the HF Amateur may have. This wide selection allows any operator to assemble a station which meets his needs, and assures compatible interfacing and styling instead of a desk full of equipment with a variety of styling and poor operation as a system.
KILOWATT AMPLIFIER
Everyone wants to be heard! The accessory L75 and its 3-500Z (1200 watts PEP input) and a decent antenna will do the trick. This rugged self-contained amplifier/power supply will put the TR5 on an even footing with the best of them.
ENGINEERING
The TR5 and all Drake Transceivers, are backed by the best in engineering. The TR5 is the result of an extensive engineering effort, combining proven past techniques and ideas with new state of the art concepts.
As a result, the TR5 will not be superceded by a new model every six months. It represents a true radio communications value that will provide many years of operating enjoyment.
Features, availability and prices subject to change without notice or obligation.
See your Drake dealer or write for additional information.
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AMATEUR RADIO ANTENNA LENGTH CHART

	FREQUENCY (Mhz)	1/4λ (Feet)	1/2λ (Feet)	1λ (Feet)	1/2λ Inv Vee 90° (Feet)
	1.800	**130' 0"**	**260' 0"**	**558' 4"**	**257' 5"**
	1.850	126' 6"	253' 0"	543' 3"	250' 5"
160 METERS	1.900	123' 2"	246' 4"	528' 11"	243' 10"
	2.000	**117' 0"**	**234' 0"**	**502' 6"**	**231' 8"**
	3.500	**66' 10"**	**133' 9"**	**287' 2"**	**132' 5"**
	3.750	62' 5"	124' 10"	268' 0"	123' 7"
80 METERS	3.900	60' 0"	120' 0"	257' 8"	118' 10"
	4.000	**58' 6"**	**117' 0"**	**251' 3"**	**115' 10"**
	7.000	**33' 5"**	**66' 10"**	**143' 7"**	**66' 2"**
40 METERS	7.150	32' 9"	65' 5"	140' 7"	64' 10"
	7.300	**32' 1"**	**64' 1"**	**137' 8"**	**63' 6"**
30 METERS	**10.100**	**23' 2"**	**46' 4"**	**99' 6"**	**45' 10"**
	10.150	**23' 1"**	**46' 1"**	**99' 0"**	**45' 8"**
	14.000	**16' 9"**	**33' 5"**	**71' 9"**	**33' 1"**
	14.150	16' 6"	33' 1"	71' 0"	32' 9"
20 METERS	14.300	16' 4"	32' 9"	70' 3"	32' 5"
	14.350	**16' 4"**	**32' 7"**	**70' 0"**	**32' 3"**
17 METERS	**18.068**	**12' 11"**	**25' 11"**	**55' 7"**	**25' 8"**
	18.168	**12' 11"**	**25' 9"**	**55' 4"**	**25' 6"**
	21.000	**11' 2"**	**22' 3"**	**47' 10"**	**22' 1"**
15 METERS	21.200	11' 0"	22' 1"	47' 5"	21' 10"
	21.450	**10' 11"**	**21' 10"**	**46' 10"**	**21' 7"**
12 METERS	**24.890**	**9' 5"**	**18' 10"**	**40' 5"**	**18' 7"**
	24.990	**9' 4"**	**18' 9"**	**40' 3"**	**18' 6"**
	28.000	**8' 4"**	**16' 9"**	**35' 11"**	**16' 7"**
10 METERS	28.500	8' 3"	16' 5"	35' 3"	16' 3'
	29.700	**7' 11"**	**15' 9"**	**33' 10"**	**15' 7"**
6 METERS	**50.000**	**4' 8"**	**9' 4"**	**20' 1'**	**9' 3"**
	54.000	**4' 4"**	**8' 8"**	**18' 7"**	**8' 7"**
2 METERS	**144.000**	**1' 8"**	**3' 3"**	**7' 0"**	**3' 3"**
	148.000	**1' 7"**	**3' 2"**	**6' 9"**	**3' 2"**

Antenna length calculations are based on the following formulas:
1/2 wave dipole (feet) = 468/frequency in Mhz
Full wave loop (feet) = 1005/frequency in Mhz
Inverted Vee with 90 degree included angle is 93% the length of 1/2 wave dipole

Note:
Cut wire slightly longer to allow for connecting insulators and pruning.
Height above ground, nearby wires, trees, etc. will change tuning slightly.

MILLENNIA ARTS

MID-STATE AMATEUR RADIO CLUB

The Mid-State Amateur Radio Club meets the THIRD SATURDAY 8:00 AM of each month at the Johnson County REMC building 750 International Dr. Franklin, IN 46131

See our website, www.midstatehams.org, for maps on how to get to our meeting.

Everyone is welcome; you do not have to be a *HAM* to attend our meetings or a member of the club.

W9MID Repeater:
Offical SkyWarn Repeater for Johnson County

146.835/
146.235 MHz
(151.4 Hz PL Tone)

W9MID Repeater:

443.525/
448.525 MHz
(151.4 Hz PL Tone) YEASU SYSTEM FUSION (C4FM)

Club Officers:

President: Tim Aldridge - WC9G
Vice President: Rhonda Curtis - WS9H
Secretary: Jim Adams – KB9JMU
Treasurer: Jacki Frederick - KI6QOG
Repeater Trustee: Chris Frederick – KQ9Y
Club Historian: Art Bleicher – WB9CHR
Club P.I.O. : Rhonda Curtis – WS9H

Weekly Net: Sunday evening 7:00 PM ARES/RACES members and ALL RADIO AMATEURS
146.835/146.235 MHz (151.4 Hz PL Tone)

The Official Newsletter of the Mid-State Amateur Radio Club
857 Lionshead Lane
Greenwood, Indiana
46143
Spark Gap Editor: Robert LaGrange N9SIU

Please send your articles to my email: n9siu@yahoo.com no later than the 3rd week of the month.

Thanks to Johnson Co. REMC for the use of their building for meetings and testing.

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